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10/676,922	10/01/2003	David E. Lowell	200309154-1	8294

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EXAMINER
WAI, ERIC CHARLES

ART UNIT	PAPER NUMBER
2195	

NOTIFICATION DATE	DELIVERY MODE
08/08/2008	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 May 2008*.

2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-66* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-66* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3)☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5)☐ Notice of Informal Patent Application
6)☐ Other: _____.

DETAILED ACTION

1.   Claims 1-66 are presented for examination.

2.   In view of the Appeal Brief filed on 05/27/2008, PROSECUTION IS HEREBY

REOPENED. A new ground of rejection is set forth below.

3.   To avoid abandonment of the application, appellant must exercise one of the

following two options:

        (1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply

under 37 CFR 1.113 (if this Office action is final); or,

        (2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed

by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and

appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth

in 37 CFR 41.20 have been increased since they were previously paid, then appellant

must pay the difference between the increased fees and the amount previously paid.

4.   A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by

signing below.

Claim Rejections - 35 USC § 102

5.   The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that

form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6.   Claims 1-8,10,12-14,16-19, 25-26, 28-34, 36-38, 44, 46-51, 53-57, 61, 63, and 65-66 are rejected under 35 U.S.C. 102(e) as being anticipated by Bennett et al. (US PG Pub No. US 2004/0117532 A1 hereinafter Bennett).

7.   Regarding claim 1, Bennett teaches a computer including an I/O device ([0019]), a method comprising using a virtual machine monitor to commence virtualization of the I/O device at runtime ([0053] lines 8-12 and [0054] lines 10-14, wherein VMM sets the interrupt control indicator bit to indicated that the VMM handles the interrupt during runtime, i.e. handing I/O interrupts by the VMM is I/O device virtualization; [0023], wherein VMM sets the interrupt control indicator before transferring control to the VM, i.e. at runtime).

8.   Regarding claim 2, Bennett teaches that the computer further includes a CPU, wherein the virtual machine monitor is in control of the CPU prior to the runtime virtualization of the I/O device ([0049] wherein the VMM determines how to handle the interrupt, i.e. occupying CPU time).

9.   Regarding claim 3, Bennett teaches that the virtualization is performed

transparently to the operating system ([0015] and [0019], wherein VMMs are used to

run higher level software such as operating systems).

10.   Regarding claim 4, Bennett teaches that the I/O device is compatible with the

virtualized I/O device ([0019], wherein they must be compatible in order for the

virtualization to be transparent).

11.   Regarding claim 5, Bennett teaches that the virtualization includes commencing

I/O device emulation at runtime ([0049], wherein the VMM emulates delivery of the

interrupt; [0030], wherein interrupts are generated by I/O devices).

12.   Regarding claim 6, Bennett teaches configuring the hardware to trap I/O

accesses, and enabling the virtual machine monitor to emulate the I/O device in

response to the traps ([0049], wherein the VMM must trap I/O access to emulate

delivery of the interrupt; [0030], wherein interrupts are generated by I/O devices).

13.   Regarding claim 7, Bennett teaches that the virtual machine monitor uses

memory management to trap the I/O accesses ([0023] and [0026] wherein the VMCS is

used to check the source of interrupts).

14.   Regarding claim 8, Bennett teaches that the virtual machine monitor can commence the emulation between I/O sequences ([0019] wherein the VMM emulates operation for the physical resources whenever VMs require such resources).

15.   Regarding claim 10, Bennett teaches that the virtual machine monitor can commence the emulation in the middle of an I/O sequence ([0019] wherein the VMM emulates operation for the physical resources whenever VMs require such resources).

16.   Regarding claim 12, Bennett teaches that the runtime virtualization includes using the virtual machine monitor to emulate I/O device interrupts ([0049], wherein the VMM must trap I/O access to emulate delivery of the interrupt; [0030], wherein interrupts are generated by I/O devices).

17.   Regarding claim 13, Bennett teaches that the I/O device interrupts are directed to the operating system prior to the runtime virtualization of the I/O device ([0028]); and wherein the I/O device interrupts are directed to the virtual machine monitor during and after the virtualization of the I/O device ([0031]).

18.   Regarding claim 14, Bennett teaches that the virtual machine monitor temporarily pauses an I/O sequence by emulating the I/O device as being busy ([0054] lines 10-14, wherein the interrupt controller interface logic masks all interrupts preventing delivery).

19.   Regarding claim 16, Bennett teaches devirtualizing the I/O device at runtime

following the runtime virtualization ([0055] lines 1-5, wherein the VM1404 manages the

interrupts).

20.   Regarding claim 17, Bennett teaches a computer including hardware, a virtual

machine monitor running on the hardware, an operating system running on the virtual

machine monitor, the hardware including an I/O device, the I/O device already

virtualized by the virtual machine monitor, a method comprising devirtualizing the I/O

device at runtime ([0055] lines 1-5, wherein VMM402 modifies the interrupt control

indicator to allow VM1404 to manage all interrupts, i.e. devirtualizing).

21.   Regarding claim 18, Bennett teaches that the devirtualization is performed

transparently to the operating system ([0015] and [0019], wherein VMMs are used to

run higher level software such as operating systems).

22.   Regarding claim 19, Bennett teaches that the devirtualization includes stopping

I/O device emulation at runtime ([0054] lines 1-4, wherein the VMM no longer handles

the interrupts).

23.   Regarding claim 25, Bennett teaches re-directing interrupts from interrupt

handlers in the virtual machine monitor to interrupt handlers in the operating system

([0055]).

24.   Regarding claim 26, Bennett teaches configuring the hardware so the accesses

by the operating system to the I/O device no longer trap to the virtual machine monitor

([0055]).

25.   Regarding claim 28, Bennett teaches that the I/O device is virtualized at runtime

again after having been devirtualized at runtime ([0053-54], wherein interrupt handling

can be transferred to the VMM again).

26.   Regarding claims 29-34, 36-38, 44, and 46, they are the computer claims of

claims 1, 4-7, 10, 12, 14, 17, 26, and 28 above. Therefore they are rejected for the

same reasons as claims 1, 4-7, 10, 12, 14, 17, 26, and 28 above.

27.   Regarding claims 47-51, 53-57, 61, 63, and 65-66, they are the article claims of

claims 1, 5-7, 10, 12, 14, 17, 19, 26, and 28 above. Therefore they are rejected for the

same reasons as claims 1, 5-7, 10, 12, 14, 17, 19, 26, and 28 above.

Claim Rejections - 35 USC § 103

28.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

29.   Claims 9, 11, 15, 20-24, 27, 35, 39-43, 45, 52, 58-62, and 64 are rejected under

35 U.S.C. 103(a) as being unpatentable over Bennett et al. (US PG Pub No. US

2004/0117532 A1).

30.   Regarding claim 9, Bennett teaches that the virtual machine monitor commences

emulation by intercepting I/O accesses ([0019] wherein the VMM emulates operation for

the physical resources whenever VMs require such resources).

31.   Bennett does not teach that the virtual machine monitor uses the intercepted I/O

accesses to change the state of a state machine, whereby the state machine reflects

the state of the I/O device; and wherein the virtual machine monitor examines

transitions in the state of the state machine to determine whether the I/O device is in the

middle of an I/O sequence.

32.   It would have been obvious to one of ordinary skill in the art at the time of the

invention to include the use of a state machine. One would be motivated by the desire

to have a method of representing the state of the I/O device to track its operation.

33.   Regarding claim 11, Bennett does not teach that the virtual machine monitor

uses a state machine to determine whether the I/O device is in the middle of an I/O

sequence, and delays commencing emulation until the state machine indicates that I/O

sequence has completed.

34.   It would have been obvious to one of ordinary skill in the art at the time of the

invention to include the use of a state machine. One would be motivated by the desire

to have a method of representing the state of the I/O device to track its operation. It also

would have been obvious to delay commencing emulation. One would be motivated by

the desire to not interrupt the I/O sequence.

35.   Regarding claim 15, Bennett does not teach that the I/O device has multiple

modes of operations; wherein the virtual machine monitor determines the mode of the

I/O device prior to commencing virtualization; and wherein the virtual machine monitor

restores the determined mode of the operation after virtualization.

36.   It would have been obvious to one of ordinary skill in the art at the time of the

invention that I/O devices have multiple modes of operations. It also would have been

obvious to restore a previous mode of operation after virtualization. One would be

motivated by the desire to ensure that the virtualization proceeded transparently.

37.   Regarding claim 20, Bennett does not teach that the devirtualization includes

allowing the virtual machine monitor to temporarily stop the operating system from

commencing a new I/O sequence.

38.   It would have been obvious to one of ordinary skill in the art at the time of the

invention to include temporarily stopping the OS from commencing a new I/O sequence.

One would be motivated by the desire to ensure complete devirtualization before

processing a new I/O request.

39.   Regarding claim 21, Bennett teaches that the virtual machine monitor temporarily

stops the operating system by emulating the I/O device as being in a "busy" or "device

not ready" state ([0054] lines 10-14, wherein the interrupt controller interface logic

masks all interrupts preventing delivery).

40.   Regarding claim 22, Bennett does not teach that the virtual machine monitor

bounds the amount of time the operating system processing is temporarily stopped.

41.   It would have been obvious to one of ordinary skill in the art at the time of the

invention that the VMM bound the amount of time that the OS is stopped. One would be

motivated by the desire to ensure that the OS not be stopped indefinitely.

42.   Regarding claim 23, Bennett does not teach that the VMM logs I/O accesses by

the operating system to the I/O device during devirtualization, and replays the log to the

device after devirtualization, whereby the I/O accesses by the operating system are

deferred during the devirtualization of the I/O device.

43.   It would have been obvious to one of ordinary skill in the art at the time of the

invention to that some sort or logging and playback must occur when the device is

devirtualized. One would be motivated by the desire to track any requests that main

occur during devirtualization.

44.   Regarding claim 24, Bennett does not teach that the virtual machine monitor waits for I/Os initiated by the virtual machine monitor's driver for the I/O device to complete, and for all expected interrupts from the device to arrive, before ceasing device emulation.

45.   It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bennett to wait for I/Os initiation by the virtual machine monitor's driver for the I/O device to complete, and for all expected interrupts from the device to arrive, before ceasing device emulation. One would be motivated by the desire to ensure that all interrupts directed to the VMM are completed before transferring control.

46.   Regarding claim 27, Bennett does not teach wherein the I/O device has multiple modes of operations; wherein the virtual machine monitor determines the mode of the I/O device prior to commencing devirtualization; and wherein the virtual machine monitor restores the determined mode of the operation after devirtualization.

47.   It would have been obvious to one of ordinary skill in the art at the time of the invention that I/O devices have multiple modes of operations. It also would have been obvious to restore a previous mode of operation after devirtualization. One would be motivated by the desire to ensure that the devirtualization proceeded transparently.

48.   Regarding claims 35, 39-43, and 45, they are the computer claims of claims 11, 20-24, and 27 above. Therefore they are rejected for the same reasons as claims 11, 20-24, and 27 above.

49.   Regarding claims 52, 58-62, and 64, they are the article claims of claims 11, 20-

24, and 27 above. Therefore they are rejected for the same reasons as claims 11, 20-

24, and 27 above.

Response to Arguments

50.   Applicant's arguments with respect to claims 1-66 have been considered but are

moot in view of the new ground(s) of rejection.

Conclusion

51.   Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Eric C. Wai whose telephone number is 571-270-1012.

The examiner can normally be reached on Mon-Thurs, 8am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Meng - Ai An can be reached on 571-272-3756. The fax phone number for

the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR.

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For more information about the PAIR system, see http://pair-direct.uspto.gov. Should

you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a

USPTO Customer Service Representative or access to the automated information

system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Meng-Ai An/   /Eric C Wai/
Supervisory Patent Examiner, Art Unit 2195   Examiner, Art Unit 2195